

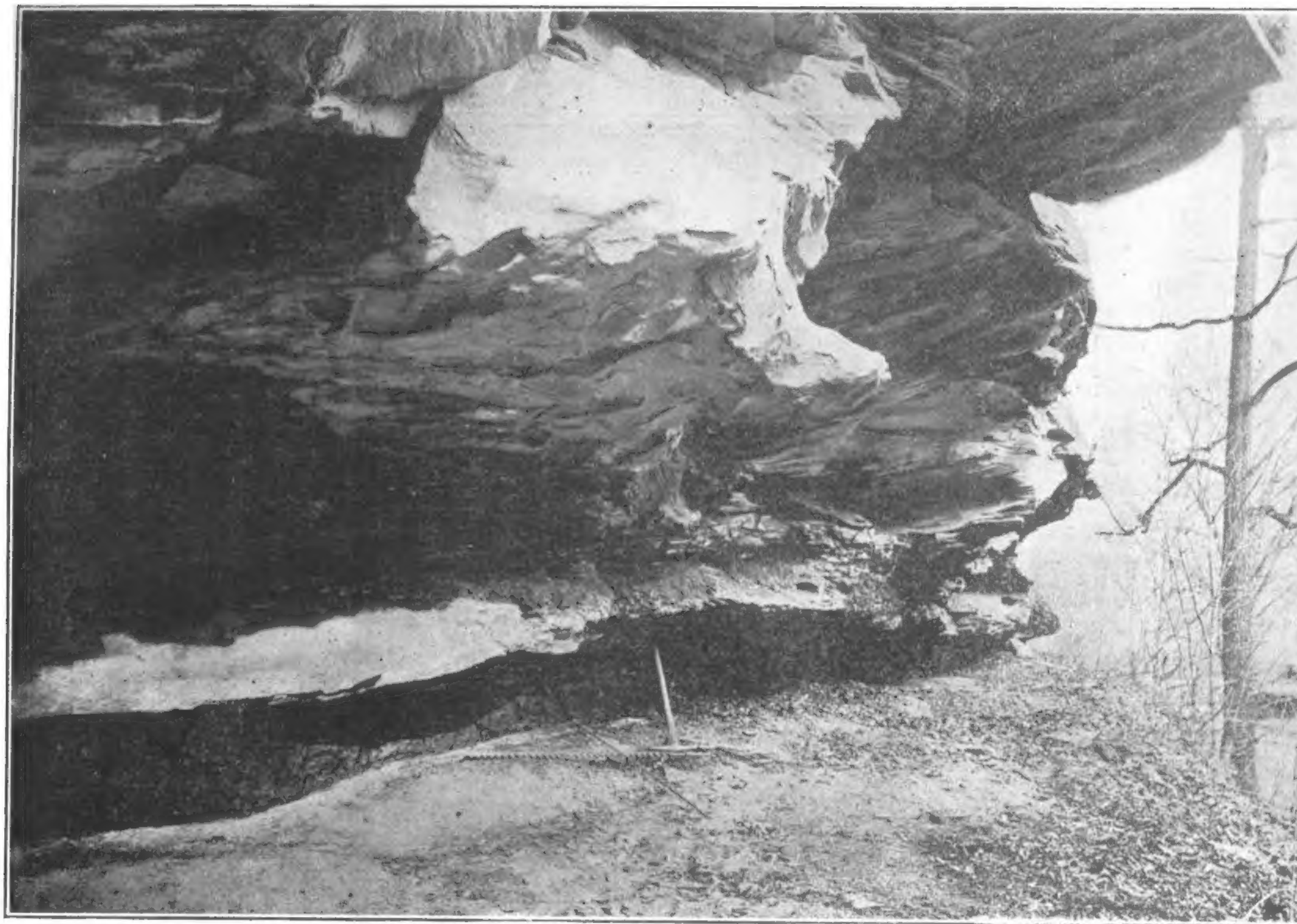
*The*  
***Kentucky Geological***  
***Survey***

WILLARD ROUSE JILLSON  
DIRECTOR AND STATE GEOLOGIST



SERIES SIX  
VOLUME SIX

*The Sixth*  
***Geological Survey***  
*1921*



**THE WHITESBURG COAL AND SANDSTONE "ROCKHOUSE" ROOF.**

This characteristic view of the well known Whitesburg coal and its superimposed thirty feet of cliff forming sandstone may be seen on Otter Creek just above its juncture with the Middle Fork of the Kentucky River in Perry County.

# THE SIXTH GEOLOGICAL SURVEY

An Administrative Report of the Several Mineral Resource  
and General Geological Investigations Under-  
taken and Completed in Kentucky  
during the Biennial Period  
1920-1921



By  
**WILLARD ROUSE JILLSON**  
DIRECTOR AND STATE GEOLOGIST

---

PRESENTED WITH TEN SEPARATE  
MISCELLANEOUS GEOLOGICAL PAPERS

BY  
GEORGE P. MERRILL,  
STUART WELLS  
WILLARD ROUSE JILLSON  
STUART ST. CLAIR  
AND  
CHARLES STEVENS CROUSE

*Illustrated with 101 Photographs  
Maps and Diagrams*

***First Edition***

1,000 Copies

THE KENTUCKY GEOLOGICAL SURVEY  
FRANKFORT, KY.  
1921



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Frankfort, Ky.

## PREFACE

Applied geology is of great economic value to every State in which natural resources are only partly developed. This is especially true of Kentucky where the great body of mineral resources are now less than 20% under commercial operation. An ideal arrangement would be one where the State would have completed the base (topographic) mapping and the preliminary geological-resource surveys prior to the opening up of any oil, coal, natural gas, asphalt or other field. During the period of proving up such a field, State employed geologists could well work hand in hand with the operators, and assist them greatly in their efforts to win the resources desired.

Unfortunately this ideal arrangement has never existed in Kentucky, though it has to some extent in other States. With only 46% of Kentucky base (topographic) mapped, and with an area approximating that of sixty counties not covered by any accurate maps at all, the function of the Kentucky Geological Survey has always been crippled and held in restraint. The day of a 100% efficiency of the Kentucky Geological Survey seems yet to be in the distant future.

During the last biennium a large number of subjects of great economic value to this State have been investigated, however, by the Kentucky Geological Survey. A full account of these investigations is presented herewith in the first paper of this volume entitled, "The Sixth Geological Survey." A number of these economic papers are included within the covers of this book, and should assist materially in an understanding of the geology and resources of the several regions covered. This report is issued in an original edition of one thousand copies.



Director and State Geologist.

Old Capitol,  
Frankfort, Kentucky.  
December 15, 1921.

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THE SIXTH  
GEOLOGICAL SURVEY

# I

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## THE SIXTH GEOLOGICAL SURVEY

(Years of 1920 and 1921)

### AN ADMINISTRATIVE REPORT

BY

WILLARD ROUSE JILLSON

DIRECTOR AND STATE GEOLOGIST

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### ORGANIZATION.

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The General Assembly of Kentucky in its regular Session of 1920 passed, "An Act abolishing the Department of Geology and Forestry, the office of Commissioner of Geology and Forestry, the office of Deputy Commissioner of Geology and Forestry, the offices of State Forester, and State Geologist attached thereto, and all other offices, officers, deputies, assistants, clerks, etc., pertaining to the Department of Geology and Forestry as provided for in chapter 35, Acts of 1918, and chapter 59, Kentucky Statutes, Carroll, Vol. 3, 1918, section 2007a—1 to 2007g—31, inclusive, and to empower the Commissioner of Agriculture, Labor and Statistics to employ necessary clerks, stenographers and laborers, and to appoint a forester, fixing his salary, to appropriate funds for the purpose of carrying out the provisions of this Act and allowing co-operation with the Game Department, and declaring an emergency to exist. H. B. 253—Lazarus<sup>1</sup>. It also passed, "An Act creating the Kentucky Geological Survey, designating its executive officer and his duties, and providing funds for its maintenance. H. B. 261—Stewart, R. L.

Governor Morrow approved these bills on March 20, 1920, which act officially reorganized the (Sixth) Kentucky Geological Survey. On April 1st the Governor appointed Willard Rouse Jillson, Director and State Geologist of the new Kentucky Geological Survey, and this important though little

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<sup>1</sup>Chapters 33 and 34 of the Acts of the General Assembly of the Commonwealth of Kentucky, 1920.

understood department of the State Government began to function immediately.

#### GOVERNING STATUTE.

The Act creating and governing the (Sixth) Kentucky Geological Survey and making appropriations for same follows:<sup>2</sup>

“AN ACT creating the Kentucky Geological Survey, designating its executive officer and his duties, and providing funds for its maintenance.

Be it enacted by the General Assembly of the Commonwealth of Kentucky:

1. Established.—That the Kentucky Geological Survey is hereby created and established, with a single executive officer, who shall be designated as the Director and State Geologist; that the offices of said survey shall be at the seat of government, Frankfort, Ky.; that the geological collections, records, maps, reports and accumulated property of former Kentucky Geological Surveys, excepting the collections of the State Museum, be, and the same are, hereby to be maintained at the offices set aside for said Kentucky Geological Survey, at Frankfort, Ky., and the money necessary for their maintenance and for the maintenance of said survey is hereby appropriated from any money in the State treasury not otherwise appropriated.

2. Director and State Geologist. Appointment.—Qualification.—Term. That the Governor shall, with the advice and consent of the Senate, appoint a technically trained geologist as Director and State Geologist of the Kentucky Geological Survey, who shall have a thorough, scientific, and practical knowledge of the sciences of geology, mineralogy, hydrography, and allied subjects. Said appointee shall be possessed of at least six years' collegiate and technical training in geology, and shall be a graduate in geology from a recognized university. Said Director and State Geologist shall make his home in Frankfort, Kentucky. He shall enter upon the

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<sup>2</sup>Chapter 34, page 141, Acts of the General Assembly of the Commonwealth of Kentucky, 1920. Approved March 30, 1920.

duties of his office immediately upon the enactment of this statute, and shall hold his office for four years, unless removed sooner by the Governor for inefficiency, incompetency or misconduct.

3. Duties of Director and State Geologist.—Reports by.—It shall be the duty of the Director and State Geologist to give his attention to the administration of the affairs of the Kentucky Geological Survey; to visit any and all parts of the State so as to make himself familiar with the needs of each section; to supervise, outline and edit the work of his assistants; to advance the interests of Kentucky by presenting in person, or otherwise before national geological meetings, authoritative statements of the geological and mineral resources of the State; to undertake such field work as his time will permit, and to perform such other duties as may properly pertain to his office. He shall have the supervision of the entire work of the survey, and shall be responsible for the accuracy of same. He shall make a brief report biennially to the Governor on January 1st, at the convening of the State General Assembly, covering the activities accomplished by and proposed for the Kentucky Geological Survey. He shall devote his entire time to the above duties as hereinbefore set out. Under the direction and control of the Director and State Geologist, the corps of the survey shall proceed to make careful geological, mineralogical, chemical, physical and soil surveys of the State; to enter upon record an accurate statement of the extent of water power and water courses, to locate coal, oil, metalliferous deposits, clays, ores, building stones, etc., etc., to report characteristics and compositions of soils and minerals; to collect, analyze, classify and label specimens of rocks, fossils, ores, coals, oils, gases, minerals, soils and other natural resources of the State; to cause specimens of the above named exhibits of the State to be correctly labeled and preserved in the museum of the State University at Lexington and in the office of the Geological Survey at Frankfort.

4. Assistants.—Expenses to be Reported.—The Director and State Geologist is authorized to employ competent assistant geologists, paleontologists, topographers, surveyors, spe-

cialists and such stenographic assistants as may be required for the proper conduct of the affairs of the survey. All traveling and field expenses of the director and his assistants, and all expenses of the Kentucky Geological Survey shall be itemized each month, and if approved by the director shall be forwarded to the auditor, who shall draw his warrants for the various amounts from funds appropriated for the maintenance of the Survey. Payment of any item of expense connected with the survey shall not be made until the approval of the director is secured in writing.

5. To Co-operate with the United States Departments.—The Director and State Geologist may enter into co-operative arrangements for geological, topographic, soil and such other surveys as are properly within the scope of the Kentucky Geological Survey, with the State Experiment Station, United States Geological Survey, the United States Department of Agriculture, or other organization of governmental departments; provided, that in each case agreed upon the said organization or department shall furnish an amount of money equal to that allotted for such work by this survey; and provided, further, that such co-operative agreements shall be made and carried out so that in all things they will prove advantageous to the State of Kentucky.

6. Salary.—The salary of the Director and State Geologist shall be \$3,000 per annum, which sum is hereby annually appropriated from any money in the State treasury not otherwise appropriated, and is in addition to the annual appropriation made for the Kentucky Geological Survey.

7. Equipment to be Furnished.—It shall be the duty of the Commissioner of Public Printing to supply the Kentucky Geological Survey with all necessary stationery, accessory printing, printing of reports and maps, etc., in the same manner as all other state offices are supplied, upon the signed requisition of the director of the survey, and with the approval of the Printing Commissioners or similar body.

8. Reports.—Concerning.—The reports of the survey shall be prepared as rapidly as possible, and shall be reviewed, edited and approved by the director, who shall requisition



the printing of same through the Commissioner of Public Printing, the cost thereof to be paid out of the general expenditure fund as in the case of other official reports. The director is authorized to publish in the daily and weekly newspapers, trade journals, geological magazines or in pamphlet form any geological discoveries or results of especial interest, the cost of such publications, if any, to be paid out of the general expenditure fund not to exceed the sum of five thousand dollars. No reports or maps prepared by the Kentucky Geological Survey shall be sold, but nominal charges to cover postage may be made, and all stamps when so received shall be kept and reused without itemization by the survey.

9. Appropriation.—For the purpose of carrying into effect the provisions of this Act, there is hereby appropriated the sum of \$15,000.00 annually for the geological, chemical, technical, soil and other investigations authorized by this Act, including all salaries and field expenses, clerical assistance, laboratory, field equipment, supplies, freight charges, and all necessary miscellaneous items of permanent improvement to the property and effects of the Kentucky Geological Survey; and the further sum of \$12,500.00 annually for topographical surveys in co-operation with the United States Geological Survey, subject to the provisions of Section 5, of this Act; provided, that in the event it should at any time prove that said co-operative work is not being conducted to the best advantage to the State, the Director of the Kentucky Geological Survey is hereby authorized to withdraw from such co-operation, when so advised by the Governor, and the mapping may be continued by the Kentucky Geological Survey alone, or the unexpended balance be turned back into the treasury and the appropriation for said co-operative surveys cease or be used for such other purposes of the survey as the director may indicate.

10. Emergency.—Whereas, the law relating to the Department of Geology and Forestry has been repealed at this session of the General Assembly, thereby setting aside any and all appropriations belonging to geological research in this State,

and whereas, there are now no funds available for this work or to support the Geological Survey, herein provided for, an emergency is declared to exist, and this Act and its appropriations shall, therefore, go into effect immediately upon its approval by the Governor.

Approved March, 20, 1920.

EDWIN P. MORROW, Governor."

### PREVIOUS SURVEYS.

The work of mapping the geology and the mineral resources of Kentucky was begun under the official act of the State in 1838, when by legislative action Dr. William Williams Mather, of Albany, New York, made the first reconnaissance survey of Kentucky. This report was published in 1839 as a legislative paper.<sup>3</sup> Although a State-wide survey with adequate appropriations was outlined in Mather's report, no actual Kentucky Geological Survey was provided for by legislative enactment until 1854, when the first survey under the leadership of Dr. David Dale Owen, of New Harmony, Indiana, was organized by legislative enactment. This survey functioned until the death of Dr. Owen in 1859, its last publication, Vol. IV of the Series I, appearing in 1860.

An hiatus during the time of the Civil War was followed by the reorganization of the (Second) Kentucky Geological Survey in 1873 under the direction of Dr. Nathaniel Southgate Shaler, of Newport, Kentucky, and Cambridge, Mass. The Shaler survey terminated with the resignation of its Director in 1880, and was followed by a slight reorganization in 1880 so as to include the Bureau of Immigration, and Mr. John Robert Procter, of Maysville, Kentucky, formerly an assistant of Dr. Shaler, was made the Director. During the Procter term, which continued up to the abolishment of the Kentucky Geological Survey in 1892, this organization was commonly known still as the (Second) Kentucky Geological Survey.

A widespread lapse of interest in the mineral and geological development of Kentucky, at this time, became responsible for the second lengthy period during which nothing was done

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<sup>3</sup>Pp. 239-278 Ky. House of Rep. Jour., 1838-39.

by the State to assist in geological investigations within its borders. The General Assembly of 1904 became convinced of the shortsightedness of this program for a State as rich in mineral deposits as Kentucky, and reorganized at its regular session of 1904 the (Third) Kentucky Geological Survey. Prof. Charles Joseph Norwood, of Lexington, Kentucky, the then State Inspector of Mines, was made Director and State Geologist by legislative enactment. This survey functioned until 1912, when shortly following the opening of the McCreary administration a Bill was introduced which in effect abolished the Norwood survey, and created the (Fourth) Kentucky Geological Survey. Mr. Joseph Bernard Hoeing, of Lexington, Kentucky, an Engineer and Geological Assistant on the several Shaler-Procter-Norwood Surveys, was appointed State Geologist.

The Fourth Kentucky Geological Survey functioned until 1918, when again by shortsighted methods and means political, it was combined with the State Board of Forestry, the appropriations for which had been entirely withdrawn. Under the new title of the Office of Commissioner of Geology and Forestry this the (Fifth) Kentucky Geological Survey, which later became known generally as the Department of Geology and Forestry, functioned until March 20, 1920. For this fifth Survey Mr. John Earle Barton acted as Commissioner and State Forester, and Prof. Willard Rouse Jillson as Deputy Commissioner and State Geologist, both under appointment of Gov. A. O. Stanley. Chapter 33 of the Acts of the General Assembly, 1920, abolished this department, and recreated the (Sixth or Present) Kentucky Geological Survey, which by reason of the emergency clause carried in the creating Act, began to function April 1, 1920, with the appointment by Gov. Edwin P. Morrow of the present Director and State Geologist.

#### PERSONNEL OF THE (SIXTH) KENTUCKY GEOLOGICAL SURVEY.

Following upon the reorganization of the (Sixth) Kentucky Geological Survey, the following personnel of scientific assistants and trained office workers was established during 1920

and 1921. The most of these assistants are known as "temporary employees," having been engaged for a summer field season of two or three months to do a special piece of geological or mineral resource investigation.

Willard Rouse Jilison, B. S., M. S., Sc. D., Frankfort, Ky., Director and State Geologist.

Charles Henry Richardson, Ph. D., Syracuse, N. Y., Assistant Geologist.  
Stuart Weller, Ph. D., Chicago, Ill., Assistant Geologist.

Leonidas Chalmers Glenn, Ph. D., Nashville, Tenn., Assistant Geologist.  
Heinrich Ries, Ph. D., Ithaca, N. Y., Assistant Geologist.

Walter H. Bucher, Ph. D., Cincinnati, O., Assistant Geologist.

Charles H. Butts, M. S., Washington, D. C., Assistant Geologist.

Louis W. Currier, M. S., Boston, Mass., Assistant Geologist.

Stuart St. Clair, M. A., Winchester, Ky., Assistant Geologist.

Floyd Hodson, A. B., Ithaca, N. Y., Geologic Aide.

James S. Hudnall, B. S., Bowling Green, Ky., Geologic Aide.

Benjamin B. Cox, B. S., Chicago, Ill., Geologic Aide.

H. V. Tygrett, B. S., (?) Bowling Green, Ky., Geologic Aide.

R. A. Jones, B. S., Chicago, Ill., Geologic Aide.

D. H. Davis, A. B., Ann Arbor, Mich., Geographic Aide.

John S. Carroll, Frankfort, Ky., Field Assistant.

A. B. Williams, Frankfort, Ky., Field Assistant.

A. M. Peter, Sc. D., Lexington, Ky., Chemist.

Charles Stevens Crouse, E. M., Lexington, Ky., Draftsman.

Warren R. King, C. E., Chattanooga, Tenn., Water Resource Engineer.

Mrs. James Sadler, Burgin, Ky., River Gauge-reader.

Miss A. L. Brunson, Cumberland Falls, Ky., River Gauge-reader.

Mr. James Carroll, Nevelsville, Ky., River Gauge-reader.

Mr. Chester Williams, Munfordville, Ky., River Gauge-reader.

Mr. J. M. Frasure, Langley, Ky., Secretary and Clerk.

Miss Catherine B. McNamara, Frankfort, Ky., Stenographer and Account Clerk.

Miss Ann M. Crittenden, Frankfort, Ky., Manuscript Copyist.

#### OUTLINE OF ACTIVITIES IN 1920.

During the first field season, the summer of 1920, a number of important investigations were undertaken. Dr. Richardson carried out a reconnaissance investigation covering the "Glass Sands of Kentucky." He penetrated into each county of the State in which it was known or suspected that commercial glass sands were to be found, with the result that a wealth of information concerning these important but undeveloped minerals in Kentucky was brought together. Dr. Stuart Weller, with Mr. Jones as assistant, mapped the stratigraphic and

structural geology of the Golconda sheet in Livingston and Crittenden Counties, in which is found a portion of the fluorspar district of Western Kentucky.

Dr. Glenn spent a portion of the season in Webster County re-working and revising a report on the Geology and Coals of this county. This report had first been prepared a number of years ago for the Norwood or (Third) Kentucky Geological Survey, but due to misunderstanding had never been published. Dr. Glenn also mapped the stratigraphic and structural geology of Webster County at a scale of one inch to the mile.

Prof. Currier undertook an examination of the fluorspar deposits of the State, and in the summer of 1920 practically completed a report on the fluorspar field of Western Kentucky in Livingston, Crittenden and Caldwell Counties. In the summer of 1921 he finished the work in the Western section, and also completed the field work of an examination of the Central Kentucky fluorspar deposits. Prof. Bucher spent portions of the summer of 1920 and 1921 in mapping the structural and stratigraphic geology of the Jephtha Knobs section in Shelby County, Ky. Charles H. Butts spent the season of 1920 in finishing his stratigraphic and economic examination of the Mississippian series in Southern and Eastern Kentucky.

#### OUTLINE OF ACTIVITIES IN 1921.

Throughout the past summer a number of greatly needed geological and mineral resource investigations have been carried through to completion. Dr. Ries, assisted by Mr. Floyd Hodson, spent the greater portion of the field season of 1921 in a State-wide examination of the Kentucky clays and shales, and their associated industries. This reconnaissance survey has been completed. Dr. Richardson spent the summer of 1921 in a reconnaissance examination of the "Building Stones of Kentucky," in which he examined every important rock producing county in the State, and brought to light not only a number of new and excellent limestones and sandstones, but about twenty very commercial and heretofore unknown varieties of marble. W. R. King, assisted by Mrs. Jas. Sadler, Mr.

James Carroll, Mr. Chester Williams and Miss A. L. Brunson, Gauge-readers, spent the summer of 1920-1921 in making field examinations and in collecting stream flow data with respect to the "Water Power Resources of Kentucky."

During the past two years, although the time of the Director, Dr. W. R. Jillson, might have been fully taken up in the official administration of the expanded affairs of the Survey, he has found it possible to make personally the necessary field examination and write the manuscript for twenty separate and distinct geological reports within Kentucky. These reports which are now in print, have covered the economic subjects of oil shales, oil and gas, coal, rock asphalt, and fluor-spar, as well as several miscellaneous geologic titles. In this work Dr. Jillson has been assisted by Mr. John S. Carroll, Mr. J. S. Hudnall, Mr. H. V. Tygrett, and Mr. A. B. Williams.

During the field season of 1921, Dr. Stuart Weller, assisted by Mr. B. B. Cox, has been engaged in the mapping of the structural geology of the Princeton Quadrangle in the Western Kentucky fluorspar field. This quadrangle includes portions of Caldwell, Lyon, Crittenden and Hopkins Counties. Mr. D. H. Davis has spent the summer of 1921 in regional geographic studies confined to the Jackson Purchase region of Kentucky, which includes Ballard, Carlisle, Hickman, Fulton, McCracken, Graves, Marshall and Caldwell Counties.

#### TOPOGRAPHIC MAPPING.

During the years 1920-1921 the co-operative topographic mapping agreement between the United States Geological Survey and the Kentucky Geological Survey has been continued, as a result of which \$12,500.00 has been devoted to this work by each of these organizations. The designation of the location of the areas to be mapped is vested in the Director of the Kentucky Geological Survey; and the appointment of trained engineers is made by the Director of the United States Geological Survey. As a result of this co-operative agreement, the Golconda Quadrangle in Livingston and Crittenden Counties in Western Kentucky, the Glenmore Quadrangle in Warren, Butler and Edmonson Counties, and the northern half



of the Bowling Green Quadrangle, covering portions of Warren, Simpson and Allen Counties, were finished in the season of 1920. In the season of 1921, the Bowling Green Quadrangle was finished, and the Fords Ferry Quadrangle, including parts of Crittenden, Livingston, Caldwell and Lyon Counties, in Western Kentucky, was completed. In this same season the mapping of the Mammoth Cave Quadrangle, including portions of Edmonson, Warren, Barren and Hart Counties, was undertaken, as was the mapping of the Frankfort Quadrangle, including portions of Franklin, Anderson and Woodford Counties, in central Kentucky. The Frankfort (Special) Capitol City Map, scale of 1-24,000 was also completed and published. The Golconda Quadrangle has been engraved and is now being distributed.

As a result of these topographic surveys which have been continued now for several years, 46.4% of the State of Kentucky was on August 1, 1921, completely mapped. This leaves a balance of 53.6% of the State of Kentucky which has never been mapped, and is more or less imaginary on all maps of the State of Kentucky. The total amount of topographic mapping now completed in Kentucky compares very unfavorably with those sister States of Kentucky which have a similar topography, as the following letter from the Director of the U. S. Geological Survey shows:

Dr. W. R. Jillson,  
State Geologist and Director,  
Frankfort, Ky.

“August 27, 1921.

My Dear Dr. Jillson:

In reply to your letter of August 22:

The following table gives the percentage of completed topographic mapping in Kentucky, Ohio, West Virginia, Virginia and Tennessee to August 1, 1921:

| State               | Percentage Completed.<br>August 1, 1921. |
|---------------------|--|
| Kentucky .....      | 46.4                                     |
| Ohio .....          | 100                                      |
| West Virginia ..... | 100                                      |
| Virginia .....      | 84.6                                     |
| Tennessee .....     | 50.6 +                                   |

Yours very truly,  
GEO. OTIS SMITH,  
Director.”

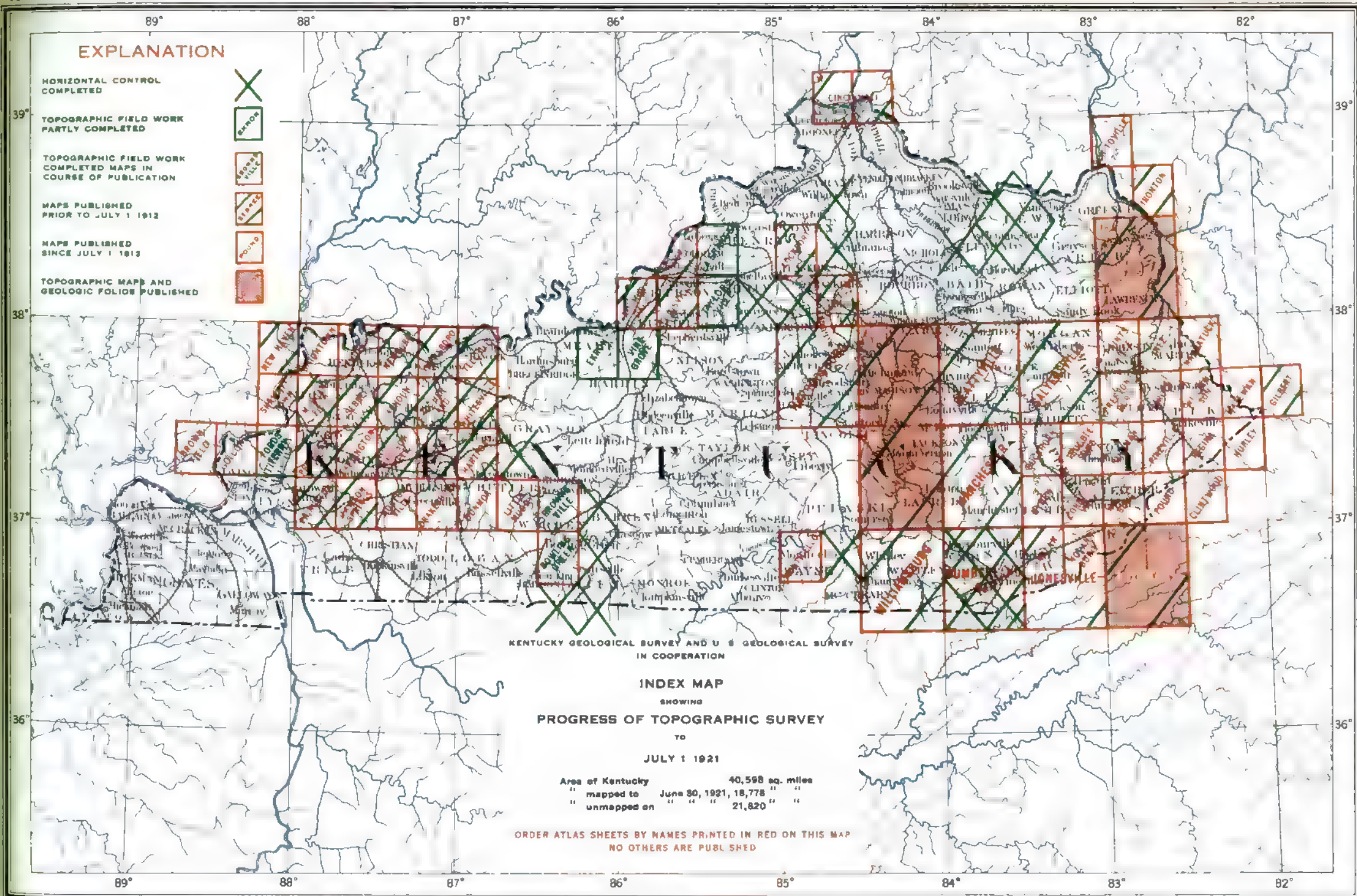
DEPARTMENT OF THE INTERIOR  
FRANKLIN K. LANE, SECRETARY  
U.S. GEOLOGICAL SURVEY  
GEORGE OTIS SMITH, DIRECTOR

KENTUCKY-GEOLOGICAL SURVEY  
WILLARD ROUSE JILLSON  
DIRECTOR AND STATE GEOLOGIST



#### TYPE OF NEW TOPOGRAPHIC MAP.

This is a portion of the new Golconda base map recently published covering parts of Livingston and Crittenden Counties, Ky., and parts of Illinois. The region shown is the largest fluorspar producing area of the United States.





An indexed map showing in colors the number of sheets and the area mapped up to July 1, 1921, is enclosed within this report. A glance at this map will also show the large and important areas of the State which are as yet unmapped.

#### RESULTS OF INVESTIGATIONS 1920-1921.

Investigations made by the several special and technical assistants of the Kentucky Geological Survey under the leadership of the Director and State Geologist have brought to light many important facts concerning unknown and undeveloped mineral resources of the State of Kentucky.

Dr. Richardson's glass sands investigation in 1920, now published, shows this State to have almost unlimited deposits of glass sands suitable for every known commercial use. It has been found that there are many locations in the State, both in Eastern and Western Kentucky, where deposits of commercially pure glass sands and an abundance of natural gas for fuel purposes in close proximity are located. In Eastern Kentucky this is true of the Big Sandy Valley and the Carter County section. In Western Kentucky, it is true of both Grayson and Hardin Counties. Excellent deposits of glass sands, removed from large fuel supply, but suitable for railroad transportation, have been located near Marion, in Crittenden County, Carrollton, in Carroll County, and many other advantageous points in the State.

Dr. Stuart Weller's mapping of the Goleconda sheet, which is a part of the fluorspar area of Western Kentucky and a unit with the Rosiclare section of Southern Illinois, has shown that region to be extremely faulted. This geologic mapping has opened up a very tempting field for fluorspar prospecting and mine extension work, since it is definitely known that the occurrence of fluorspar in Western Kentucky is associated with the major faults. Prof. Carrier's work on the deposits of fluorspar in this State has brought out many new and interesting conditions of occurrence and origin which will materially help the development of this industry in Kentucky.

Dr. Glenn's report on the "Geology and Coals of Webster County" is a thorough and painstaking piece of mapping.

coupled with a discussion of economic geology, which is in reality a distinct contribution to the Kentucky literature. Since Webster County, because of its geographic position, is the key to the Western Coal Field, this report will serve as a guidepost for all future geological work in this portion of Kentucky. The correlation of the coals as outlined by Prof. Glenn will facilitate a better understanding and appreciation of the various seams now commercialized in this region. There can be no doubt but what this report will hasten the development of coal in the Western Kentucky coal field as soon as normal conditions in that industry again obtain.

The work of Mr. Charles H. Butts on the Mississippian series in Eastern and Western Kentucky has been so thorough and so broad in its scope, that it will prove when published a veritable mine of information for the further geological and mineral development of this very large area. While much of the material in this report is of a scientific nature, necessarily, the economic side has not been overlooked. As a result of this fortunate combination, the report teems with information which can be put to excellent commercial use by those who are alert to such values and their industrial application.

Dr. Bucher's work on the Jephtha Knobs section, in Shelby County, Kentucky, while covering a relatively small area, is important, since it will finally establish the geological factors which have operated to produce this singular Blue Grass promontory. This report, which is both structural and stratigraphic, will also throw additional light on the possibilities of securing oil and gas in this section of the State, where the first prospecting, but recently completed, has proven unproductive.

Of the very greatest importance to the present industrial development of Kentucky is the report of Dr. Heinrich Ries on the clays and shales of Kentucky, and their associated industries. Dr. Ries is the ablest American authority on this subject. His report, which will bring together the results of his 3,000 mile reconnaissance in this State, when published, will prove a fundamental source of information. The real im-

portance of this work becomes apparent when it is realized that the clay and shale products industries gave to the State of Kentucky in the year of 1908 a return of \$2,239,108. Within ten years this industry trebled itself in Kentucky, for in the year 1918 its total production amounted to the very significant figure of \$6,172,554. Investigations made by Dr. Ries show large amounts of excellent pottery, brick, ornamental and roofing tiles, clays and shales in this State, as yet untouched. One of the greatest contributions is the information relative to the immense deposits of undeveloped, and, in a large measure, unknown, fire clays of southeastern Rowan and northwestern Elliott Counties. This deposit of virgin flint fire clay exists south of the known and developed Olive Hill section of Carter County, and suggests that in the future this very poor section of Eastern Kentucky may come to be, from a mineralogical and industrial standpoint, another of its wealthy regions.

Under co-operative agreement with the United States Geological Survey, Water Resource Division, new work has been done and old work continued in the gauging of the principal rivers of this State. Using the data thus obtained, manuscript has now been prepared by W. R. King, District Engineer, United States Geological Survey, for a report on the "Water Power Resources of Kentucky," which it is hoped may be published by the Kentucky Geological Survey in the near future. Demand for this sort of investigation has been greatly increased during the last few years, and this report, since there is nothing of a comprehensive nature on this subject in the Kentucky literature, will prove of much value and benefit to this State.

The work of Prof. D. H. Davis on the "Regional Geography of the Jackson Purchase," that section west of the Tennessee and east of the Mississippi River, including the counties of Ballard, Carlisle, Hickman, Fulton, McCracken, Graves, Marshall and Calloway, will serve a broad use in calling attention to the mineral, agricultural and industrial development of this rich and important westernmost section of the State. The de-



tailed and systematized studies of the industries, the soils and their productivity, the geology and its relation to social and economic development, will prove of great benefit, since it will lead to presenting a clearer and more accurate understanding of the fundamental principles upon which the wealth and prosperity of this region is based.

The personal research work of the Director and State Geologist, Dr. W. R. Jillson, has during the past two years covered a wide field of geological investigation in Kentucky. His reports on oil shale, asphalt, oil and gas, coal, fluorspar, general geology, etc., have been in great demand by the general public, and to such an extent that Vol. II, Series VI, "Economic Papers on Kentucky Geology," in which many of these reports were contained, which was published in May, 1921, in an edition of 2,000 copies, is now rapidly approaching exhaustion, only about 200 remaining at the time of this writing. The necessary field work, followed by the manuscript writing and book-making of these reports, has been completed by the Director in addition to his statutory or official duties as head of the Kentucky Geological Survey. These engagements, coupled with a growing official correspondence, the greater portion of which is of a technical nature, demanding library, experimental or analytical research, has required the very closest application throughout this period. Office hours of the Director have been extended frequently from ten to fourteen hours per day, including Sundays and holidays, in an effort to keep ahead of amassing detail of the Survey organization.

#### OFFICE WORK.

The office work of this Survey has been carried on with one permanent and one temporary employee, and has totaled 9,549 letters received and 7,060 new letters written and sent out. The average number of letters received per day has been 25, and the average number sent out per day has been a little more than 18. The detail by months and years is given in the following table:

## Correspondence through U. S. Post Office at Frankfort, Ky.

(April 1, 1920, to June 30, 1921, inclusive.)

|  | Letters Received | Letters Sent       |
|--|------------------|--------------------|
| 1920 (April 1, 1920, to June 30, 1920)   |                  |                    |
| April .....                              | 694              | 325                |
| May .....                                | 689              | 438                |
| June .....                               | 539              | 463                |
| Total .....                              | 1,922            | 1,226              |
| 1920 (July 1, 1920, to June 30, 1921.)   |                  |                    |
| July .....                               | 525              | 444                |
| August .....                             | 473              | 387                |
| September .....                          | 544              | 408                |
| October .....                            | 598              | 487                |
| November .....                           | 609              | 510                |
| December .....                           | 519              | 416                |
| 1921                                     |                  |                    |
| January .....                            | 666              | 468                |
| February .....                           | 612              | 410                |
| March .....                              | 665              | 383                |
| April .....                              | 809              | 968                |
| May .....                                | 882              | 451                |
| June .....                               | 725              | 502                |
| Total .....                              | 7,627            | 5,834              |
|  | 1,922            | 1,226              |
| Total, April 1, 1920, to June 30, 1921.. | 9,549            | 7,060 <sup>4</sup> |
| Daily average .....                      | 25               | 18 + <sup>4</sup>  |

## PUBLICATIONS SERVICE.

One of the chief activities of the Kentucky Geological Survey is the furnishing of detailed and accurate geological and scientific information concerning the minerals and natural resources of Kentucky. In this State and nation-wide service during the past biennial period 15,326 geological reports and maps have been sent from this office in response to written or personal requests, accompanied by separate amounts of postage as required by law.

<sup>4</sup>The smaller number of letters written and sent out is accounted for by the fact that a considerable portion of the correspondence calls for the sending of particular maps or reports, and does not require other official reply.

Kentucky Geological Survey Publications Distributed Upon Request  
(April 1, 1920, to June 30, 1921, inclusive.)

|                                   |                     | Publications       |
|-----------------------------------|---------------------|--------------------|
|                                   |                     | carried in hand    |
|                                   |                     | by office visitors |
| 1920                              | Publications mailed |                    |
| April .....                       | 1,103               |                    |
| May .....                         | 938                 |                    |
| June .....                        | 885                 |                    |
| Total (April, May, June, 1920)    |                     | 74                 |
| Grand total .....                 |                     | 3,000              |
| 1920                              |                     |                    |
| July .....                        | 789                 |                    |
| August .....                      | 942                 |                    |
| September .....                   | 739                 |                    |
| October .....                     | 1,127               |                    |
| November .....                    | 1,037               |                    |
| December .....                    | 1,035               |                    |
| 1921                              |                     |                    |
| January .....                     | 1,625               |                    |
| February .....                    | 793                 |                    |
| March .....                       | 686                 |                    |
| April .....                       | 456                 |                    |
| May .....                         | 1,562               |                    |
| June .....                        | 795                 |                    |
| Total (fiscal year 1920-1921) ... |                     | 749                |
| Grand total .....                 |                     | 12,326             |
| Total, Apr. 1, 1920, to June 30,  |                     |                    |
| 1921, inclusive .....             |                     | 15,326             |
| Daily Average .....               |                     | 39 +               |

These reports and maps have covered every known subject relative to the geology, the soils, and mineral resources of this Commonwealth, and have been sent to not only practically every postoffice in the State, but throughout the United States and the world at large. Requests directed from Japan, Australia, Germany and England are frequent. The total amount of postage received in this service and reused directly from April 1, 1920, to August 31, 1921, has amounted to \$1,574.08. Since this postage is in effect a revolving unit, being reused as rapidly as it is taken in, amounts in excess of a few dol-

lars are never maintained in this office. Of this considerable postage total, not one penny has been paid by the State of Kentucky in the postal dispatch of these publications, nor the large official correspondence of the Kentucky Geological Survey, during this biennial period.

The monthly and annual totals of the postage stamps received by the Kentucky Geological Survey follow:

Postage receipts from J. P. Noonan, Postmaster, Frankfort, Kentucky, from April 1, 1920, to August 31, 1921, inclusive.

|   |          |            |
|---|----------|------------|
| 1920  |          |            |
| April .....   | \$19.16  |            |
| May .....   | 44.08    |            |
| June .....  | 87.92    |            |
| July .....  | 42.60    |            |
| August .....  | 75.75    |            |
| September .....   | 35.10    |            |
| October .....   | 87.91    |            |
| November .....  | 72.38    |            |
| December .....  | 100.55   |            |
| <hr/>   |          |            |
| Total .....   | \$565.45 | \$565.45   |
| 1921  |          |            |
| January .....   | \$129.59 |            |
| February .....  | 44.05    |            |
| March .....   | 67.91    |            |
| April .....   | 38.10    |            |
| May .....   | 130.60   |            |
| June .....  | 64.20    |            |
| July .....  | 70.68    |            |
| August .....  | 49.50    |            |
| <hr/>   |          |            |
| Total .....   | \$594.63 | 594.63     |
| Postage used in office during year 1920                                   |          | 175.00     |
| Postage used in office during year 1921                                   |          | 239.00     |
| <hr/>   |          |            |
| Total amount of postage used from<br>Apr. 1, 1920, to Aug. 31, 1921 incl. |          | \$1,574.08 |

### NEW PUBLICATIONS.

The new publications which have been prepared and issued by the Kentucky Geological Survey are as follows:

Vol. I. "Glass Sands of Kentucky," 149 pages, by Charles H. Richardson, 1920.

Vol. II. "Economic Papers on Kentucky Geology." 304 pages, by Willard Rouse Jillson, 1921. This book contains the following thirteen separate reports:

1. A Preliminary Report on the Oil Shales of Kentucky.
2. Kentucky Rock Asphalt—The Ideal Road Surface.
3. Geological Problems in the Recovery of Oil and Gas in Kentucky.
4. The Production of Kentucky Crude Oils.
5. The Value and Direction of State Geological Surveys.
6. River and Forest Trails in Western Kentucky.
7. The Ultimate Source of Kentucky Crudes.
8. Production of Fluorspar in Western Kentucky.
9. Geology of Oil and Gas in Grayson County.
10. A Mauch Chunk Island in the Mississippian Seas of Eastern Kentucky.
11. The Sandy Hook Anticline—A Newly Discovered Oil and Gas Structure in Elliott County, Ky.
12. The Campbellsville Anticline in Taylor County, Ky.
13. Paint Creek—Pirate.

Vol. VI. "Sixth Geological Survey," by W. R. Jillson and Others, containing the following ten papers:

1. The Sixth Kentucky Geological Survey (Administrative Report 1920-1921), by Willard Rouse Jillson.
2. The Cumberland Falls, Whitley County, Ky., Meteorite, by George P. Merrill.
3. Geology and Coals of The Middle Fork of the Kentucky River near Buckhorn in Perry and Breathitt Counties, Ky., by Willard Rouse Jillson.
4. Oil Pools of Warren County, Ky., by Stuart St. Clair.
5. A New Method of Producing Crude Oil in Ky., by Willard Rouse Jillson.
6. Retorting Methods as Applied to Kentucky Oil Shales, by C. S. Crouse.
7. Oil and Gas Possibilities of the Jackson Purchase Region, by Willard Rouse Jillson.
8. Oil and Gas Possibilities in Caldwell County, Ky., by Stuart Weller.
9. Drainage Problems in Kentucky, by Willard Rouse Jillson.
10. Recent Mineral Production in Kentucky, By Willard Rouse Jillson.
11. The Region About Frankfort, By Willard Rouse Jillson.

The following publications have been completed in their field work and manuscript preparation, and are now in the hands of the printer:

**Manuscripts in Press.**

Vol. III. "Oil Field Stratigraphy of Kentucky," W. R. Jillson.

- Vol. IV. "Geology of the Golconda Quadrangle," Stuart Weller.  
 Vol. V. "Geology and Coals of Webster County," L. C. Glenn.  
 Vol. VII. "The Clays of Kentucky," Heinrich Ries.  
 Vol. VIII. "The Mississippian Series of Eastern Kentucky," Charles Butts.

**Manuscripts in Preparation.**

The following are incomplete and unlisted manuscripts with tentative titles:

|  |                  |
|--|------------------|
| Fluorspar Deposits of Kentucky .....         | L. W. Currier    |
| Building Stones of Kentucky .....            | C. H. Richardson |
| Geological Research in Kentucky .....        | W. R. Jillson    |
| Mineral Production in Kentucky .....         | W. R. Jillson    |
| Geology of the Princeton Quadrangle .....    | Stuart Weller    |
| Oil and Gas Papers on Eastern Kentucky ..... | W. R. Jillson    |
| Geology of the Jephtha Knobs Region .....    | Walter Bucher    |
| The Coal Resources of Kentucky .....         | W. R. Jillson    |

These reports when completed will cover the most important fields of geological research in Kentucky, and will relieve the great call for works of general and State-wide application. Their publication will allow for, as soon as the several topographic base maps can be completed, more detailed considerations of separate quadrangle areas.

**EXPENDITURES.**

The Kentucky Geological Survey receives by way of appropriation from the State of Kentucky for all of its activities a total of \$35,500.00, which is subdivided as follows:

|                                  |             |
|----------------------------------|-------------|
| General fund .....               | \$15,000.00 |
| Base mapping (Topographic) ..... | 12,500.00   |
| Printing .....                   | 5,000.00    |
| Salary of Director .....         | 3,000.00    |

This fund has been augmented by co-operative agreements as follows: Mapping fund of \$12,500.00 has been increased by the same amount, \$12,500.00, from the United States Geological Survey, with the result that \$25,000.00 has been spent annually in this State. During the past biennial period \$500.00 has been appropriated from the general fund of \$15,000.00 for water resource work, which has been met with the same amount from the United States Geological Survey, thereby insuring the expenditure of \$1,000.00 on water re-



source work in the State of Kentucky. The work on the Mississippian Series in Kentucky has also been a co-operative agreement, in which Mr. Chas. Butts, permanent employee of the United States Geological Survey, was engaged to do this work in this State, the United States Geological Survey and the Kentucky Geological Survey meeting his expenses in equal amounts.

The total expenditures of the Kentucky Geological Survey during this biennial period as given by the State Auditor are:

|                                     |             |
|-------------------------------------|-------------|
| April 1, 1920 to July 1, 1920 ..... | \$ 7,943.44 |
| July 1, 1920, to July 1, 1921 ..... | 35,497.46   |

---

Grand total from April 1, 1920, to July 1, 1921..\$43,440.90

### RECOMMENDATIONS TO GOVERNOR AND LEGISLATURE.

Investigations and discoveries of a mineralogical and economic nature which have been made by the Kentucky Geological Survey during the past biennial period have demonstrated conclusively that the State of Kentucky is literally a treasure-house for many of the crude mineral resource materials demanded by the complicated industries of the present day. The most of these materials are today either in point of first development, or unknown to the general public. The Kentucky Geological Survey, principally through its printed reports, is the only medium by which the general public may be informed concerning this unappraised and latent natural wealth of the State.

It is unfortunate that this State Department, which is logically the key to a greater and richer Kentucky, should be neglected, or given short consideration year after year, when its thoughtful encouragement and fostering with but slightly increased appropriations would result in such large and State-wide benefits. It has been estimated that for every dollar expended on geological survey investigations in States in the Appalachian Region, \$1,000.00 is ultimately brought back into the wealth of the State in which the original investment is made. This statement is not extravagant, but is if anything,

conservative. The great turnover of the moneys in the mineral development of a country, in the purchase and repurchase of materials, labor, services, as well as the direct remuneration to the State Treasury from new corporations, land and production taxes, increased and new reality assessments, is stupendous.

It is estimated by the Director and State Geologist that the total mineral and natural resources of the State of Kentucky have been developed  $18\frac{1}{2}\%$ . While no definite determination of the amount of mineral development in Kentucky is possible, due to the present system of mineral rights assessment, Table No. IV. in Article X. of this volume is offered as an approximate guide or index. It is based on the personal observations and reconnaissances of the Director and State Geologist, and is in the nature of an appraisalment.

It is a fact that this amount of development, when compared to that of the sister States of Kentucky, is pitifully small. Facts and figures prove that a larger mineral development in Kentucky has been delayed by the lack of adequate and comprehensive topographic base and geological maps of this State. The mineral resource development of Kentucky, or any other State, cannot be promoted or advanced rapidly without standard base maps and standard indexing geological reports. These the State of Kentucky has not provided for its citizens in the same measure as has its sister States, Virginia, West Virginia, Ohio, etc. The result is that these adjoining States have sprung ahead in their development, and Kentucky has lagged.

It is recommended that the Legislature of 1922 adopt some definite plans looking to the completion of the topographic base map of this State in the near future. This map is only 46.4% completed (Aug. 1, 1921), and at the rate the work is being done, it will not be finished within seventy-five years. The mapping of this State is fundamental to all highway improvement, drainage engineering, water resource engineering, mineral resource development, and many other broad regional projects. A Federal Bill looking to the completion of the topo-

graphic base map of the United States, Temple Bill No. 5230, is now in Congress, and will probably receive favorable action. Kentucky State appropriations for this important public work should be increased at least 100%, which would give then the relatively small sum of \$25,000.00 to meet the same co-operative sum from the United States Geological Survey. Such action would insure the expenditure of \$50,000.00 annually, and hasten the day when this State would be completely mapped, when this appropriation should cease.

The geological appropriation of \$15,000.00 is not adequate to bring into this State geological and other specialists of high character and ability with which to carry on the investigations necessary to the exposition of Kentucky's mineral resources. The general fund should be increased from \$15,000.00 to \$20,000.00. At the last session of the legislature \$5,000.00 was appropriated for printing, which under the present budget regulations will be extended to cover paper. It has been found that this amount is altogether too small to allow for the printing of bulletins and maps as required by the statute in sufficient quantity to supply the public demand. A number of important manuscripts and maps have been and are still held up indefinitely for lack of sufficient funds for engraving and printing. It is recommended that the present appropriation of \$5,000.00 for printing be increased to \$7,000.00. No recommendations are made concerning an increase in salary for the Director and State Geologist, the amount of which is now \$3,000.00; but it is pointed out that in the future it will be difficult to secure a man sufficiently trained to administer this important public office in the way it should be for this small amount of money.

It is recommended finally that the governing statute be modified, so that the Director may place a nominal or approximate cost price on all maps and publications and sell same to those desiring them, as is done in other States, the money derived from such proposed sale of publications to be returned and added to the printing appropriation of the Survey, and be reused for printing and engraving purposes. This policy

would allow a saving, in that smaller editions of maps and reports could be issued, and a broader service, since enlarged funds would provide for more diversified publications.

### AVAILABLE MAPS AND REPORTS.

The Kentucky Geological Survey has now ready for immediate distribution to any interested individual, corporation, company or institution requesting same, a large number of special reports and maps. These cover the general geology and the development of the many mineral resources of a large portion of the State. The early reports of the Kentucky Geological Survey are entirely exhausted, but those which can now be secured have been hereinunder listed in chronological sequence, by titles and authors. The required postal charge, and the number still available, is also indicated. The total number of reports now in stock covering the several indicated subjects is 23,245. A request for any of these publications to the Director of the Kentucky Geological Survey, when accompanied by the required amount of postage in stamps, will be promptly complied with, until the edition is exhausted. The list given is an essential duplicate of the one used in the official correspondence of the Survey.

### LIST OF AVAILABLE MAPS AND REPORTS.

October 1, 1921.

**INSTRUCTIONS FOR ORDERING:** Single copies of any and all maps and reports listed hereunder will be mailed to any interested individual, corporation, company, or institution requesting same, providing the exact postal fee as indicated is forwarded with the request. Packages will not be sent express collect. This survey will not bill any applicant for required postal charges. Avoid delay and confusion by accompanying your letter of request with money order or stamps in the proper amount. Do not send checks.

## GEOLOGIC REPORTS

## SERIES VI.

(1920—Date.)

“W. R. JILLSON SURVEY.”

|   | Required<br>Postal<br>Charge | Copies<br>in<br>Stock |
|---|------------------------------|-----------------------|
| Vol. 1.—Glass Sands of Kentucky. C. H. Richardson, 1920 .....                   | \$0.20                       | 441                   |
| Vol. 2.—Economic Papers on Kentucky Geology, W. R. Jillson, 1920 .....          | .20                          | 212                   |
| Vol. 3.—Oil Field Stratigraphy of Kentucky. W. R. Jillson, 1921. In Press ..... | .25                          |                       |
| Vol. 4.—Geology of the Golconda Quadrangle. Stuart Weller, 1921. In Press ..... | .25                          |                       |
| Vol. 5.—Geology and Coals of Webster County, L. C. Glenn, 1921. In Press .....  | .25                          |                       |
| Vol. 6.—Sixth Geological Survey. W. R. Jillson, 1921...                         | .25                          | 500                   |
| Total Copies Series VI .....  |                              | 1,153                 |

## SERIES V.

(1918-20)

“DEPT. OF GEOLOGY AND FORESTRY.”

|  |     |       |
|--|-----|-------|
| Bulletin No. 1.—Oil and Gas Resources of Kentucky, W. R. Jillson, 1919 ..... | .25 | 1,887 |
| Bulletin No. 2.—Geology of Kentucky. A. M. Miller, 1919 .....                | .25 | 144   |
| Bulletin No. 4.—Contributions to Kentucky Geology. W. R. Jillson, 1920 ..... | .20 | 922   |
| Total Copies Series V .....  |     | 2,953 |

## SERIES IV.

(1912-13)

“J. B. HOEING SURVEY.”

|  |     |     |
|--|-----|-----|
| Vol. 1, Pt. 1.—Oil and Gas Barite. Fluorspar and Lead—Water Power—Coals of the Big Sandy Valley, Geology of Tell City Quadrangle, Geology of Owensboro Quadrangle, Geology of Georgetown Quadrangle, Trenton Horizons, Chemistry of Trenton Rocks, Phosphate Deposits in Central Kentucky, Barite Deposits in Central Kentucky. 1913. Maps ..... | .30 | 383 |
|--|-----|-----|

SERIES IV.—(Continued)  
(1912-13)

"J. B. HOEING SURVEY."

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